CANADA

DEPARTMENT OF AGRICULTURE

SCIENCE SERVICE—FOREST BIOLOGY DIVISION

Vol. 14 REPORT Number 2

BI-MONTHLY PROGRESS REPORT

March-April 1958

Published by Authority of the Hon. Douglas S. Harkness, Minister of Agriculture, Ottawa

CURRENT ACTIVITIES

ATLANTIC PROVINCES

Effects of Spraying with DDT on Fall Cankerworm, Aphids, and Mites.—The fall cankerworm has been a troublesome pest on elm in Fredericton, N.B., for more than 20 years. Since 1938 a "solid-stream" sprayer has been used to prevent serious defoliation but control has been unsatisfactory owing to the limitations of the sprayer and the partial treatment of the infested area.

Population estimates indicated that complete defoliation of many trees would occur in 1957 unless spraying was effectively carried out. Owing to the threat of Dutch elm disease the City has been carrying out a program of sanitation which has involved the cutting of about 200 large, decadent trees. This has been done under the direction of a Tree Commission appointed in 1952. It was therefore particularly important to preserve the vigour of the elm trees for which the City is famous.

A mist blower with a rating of 28,000 cubic feet of air per minute at 100 m.p.h. was purchased by the City to replace the hydraulic sprayer. During the first two weeks of June about 2,900 large trees on the south side of the St. John River were sprayed with 3 per cent DDT water suspension. The spraying was effectively carried out, mostly very early in the morning or at night with the aid of a powerful searchlight. Effective deposits were found as far as 200 feet from the machine.

Examination of the foliage showed that the spray killed practically all the cankerworm larvae and there was no further evidence of feeding after spraying. As a further check on the results, trees in the sprayed and unsprayed areas were banded with tanglefoot in the fall and records kept of the number of females trapped. Only one female was taken in the sprayed area compared with a maximum of 844 per tree in the unsprayed area. Also, male adults were numerous among unsprayed trees whereas only an occasional male was seen among the trees where spraying was done.

Sampling was carried out to determine the effects on aphids and mites. The elm aphid, *Myzocallis ulmifolii* (Monell) appeared about the end of June and by mid-July was very numerous. During the summer, honey-dew from the aphids was unusually troublesome and the trees became black as a result of the sooty mould which grows on the honey-dew. Counts of aphids were made on samples of from 10 to 100 leaves at frequent intervals from July 4 to September 17 on sprayed and unsprayed trees. Averages of the number of aphids per leaf are plotted with a balanced curve in Fig. 1.

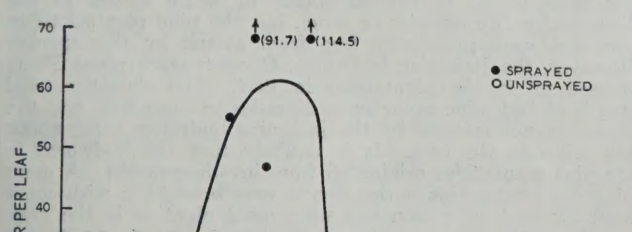

Fig. 1. Average number of Aphids per Leaf.

Although there is considerable variation in the data, they show that the population was many times greater on sprayed than on unsprayed trees. By extrapolating the curves backward it is estimated that the infestation began about June 25. There was a very marked increase in population on sprayed trees during July. It reached a peak during the last week of July, decreased rapidly during the first week in August, and returned to the level of the controls near the end of August. The sudden decrease in numbers can be partly attributed to the coccinellid predator, *Adalia bipunctata* (L.), which was numerous early in August and was present on sprayed as well as unsprayed trees during the remainder of the season. This predator was considerably more numerous on the sprayed trees, probably because of the greater number of aphids.

Counts of the spider mite, *Paratetranychus ununguis* (Jacobi), were made on the same leaves at the same time as for the aphid. The data (Fig. 2) were treated similarly. It will be seen that the number of mites was also higher on sprayed trees. The increase, however, was less marked at the beginning of the season. The numbers increased more rapidly after the first week in August and remained high into the first week in September.—C. C. Smith.

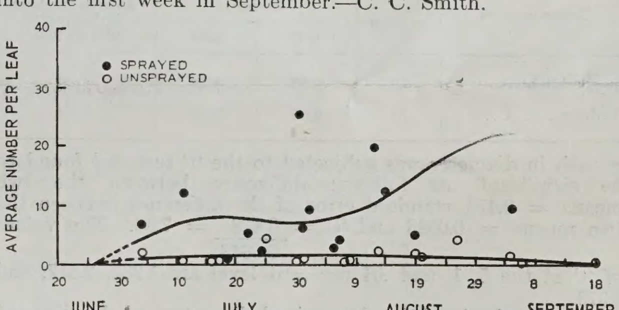

Fig. 2. Average Number of Mites per Leaf.

ONTARIO

An Unusual Feeding Habit of Tortrix alleniana Fern.—During a study of several species of tortricid larvae, one fifth-instar larva of *Tortrix alleniana* was found that contained two masses of insect fragments in the gut. These masses were removed and examined, and proved to be parts of the previous exuviae. The smaller mass, from the rectum, consisted of a pair of prolegs and part of the anal shield with some skin attached. The larger mass, from the mid-gut, consisted of parts of the prothoracic shield, thoracic legs, prolegs, and spiracles bound together by the remainder of the skin. Numerous setae were also present. Aside from the cracking and breaking of the prothoracic and anal shields, there was little indication of thorough mastication such as is found when vegetable tissue is eaten. Neither the head capsule nor the mouthparts were found and it is assumed that either these were too hard, or since the head drops away as a separate piece during ecdysis, it and the mouthparts were lost before they could be consumed.

Because this was a field-collected larva it is unlikely that this unusual feeding habit was induced by starvation. Nor is is likely that cannibalism was a factor because cannibalistic larvae usually devour their victims in small pieces rather than ingesting the body whole. The remains that were found indicate that this skin was swallowed in two pieces.

Although first-instar larvae are known to eat egg chorions and second-instar larvae of some species may feed on their first-instar exuviae (e.g. *Choristoneura fumiferana* (Clem.)—Harvey, G. T., Can. J. Zool. 35, 1957), this habit is rare among mature lepidopterous larvae (*Papilio troilus* L. and *Philosamia walkeri* F. and F.—Lutz, F. E., Fieldbook of Insects, 1935). The habit of mature tortricid larvae eating their cast skins is unrecorded.—W. Y. Watson.

Volume Growth of Needle-blighted and Healthy White Pine Trees at Mattawa, Ont.—White pine needle blight is a disease of unknown cause and origin. Trees affected by needle blight are characterized by apical injury to the foliage of the current year, which assumes a conspicuous orange-red colour. The "new" foliage on affected trees may escape injury in certain years. Diseased trees achieve inferior height and diameter increments during the growing season, and foliage and leader growth is arrested about two weeks earlier than is the case in neighbouring healthy white pine trees. Differences in diameter growth and corresponding increments in volume between needle-blighted and healthy trees growing in a local area have been the subject of studies conducted at Mattawa, Ontario.

In 1949, ten 1-acre sample plots were established in stands composed predominantly of white pine in the 60- to 70-year age class. Diameters at breast height of all tagged white pines were determined in 1949 and, again, in 1953. Heights of 30 white pine trees over a wide diameter range were also measured on each sample plot. From these data height-diameter curves were constructed and individual form-class volume tables (G. H. D. Bedell, "Form-class of white pine and jack pine as affected by diameter, height and age". Silvicultural research note No. 89, Dominion Forest Service, 1948) were computed for each sample plot.

Diseased trees used in this study were those that exhibited symptoms of needle blight on their "new" foliage in at least two summers, not necessarily consecutive, during the period 1949 to 1952 inclusive. Trees that were killed during the period in question were not considered. A total of 55 white pines of all sizes on the ten plots fitted these requirements. From each sample plot an equal number of trees which were disease-free during this same period of years and were in the same diameter class in 1949 as the diseased trees, were selected for comparison.

Table I shows the average increase in diameter for the two groups of trees during the period 1949 to 1953. The

TABLE I

Tree condition	Number of trees	Average diameter (inches)		Average diameter growth (inches) during period 1949 to 1953
		1949	1953	
Needle-blighted........	55	9.03	9.29	0.26
Healthy...............	55	9.05	9.79	0.74

growth in diameter was subjected to the 't' test and found to be significant, as follows: difference between the two means = 0.478, standard error of the difference between the two means = 0.0648 and $'t' = \frac{0.478}{0.0648} = 7.38$. The values of 't' at the 5, 1, and .01 per cent level are 1.980, 2.617, and 3.373.

On the basis of the determined diameters of the diseased and healthy trees, the total volume (in cubic feet) for each tree was computed from the individual sample plot volume tables for the beginning of the period of 1949 and for the end of the period in 1953. Table II relates the total volume for both the needle-blighted and healthy groups of trees for the years 1949 and 1953 and also gives the average annual

TABLE II

Tree condition	Number of trees	Total volume (cubic feet)		Increase in total volume 1949 to 1953	Average annual increase in volume		Growth percentage (Pressler's formula[2])
		1949	1953		cu. ft.	percentage[1]	
Needle-blighted..	55	805.71	854.97	49.26	12.32	1.53	1.48
Healthy...	55	806.49	944.84	138.35	34.59	4.29	3.95

[1]Based on 1949 total volume.
[2]Pressler's formula: Growth percentage $(P) = \frac{(V-v)}{(V+v)} \frac{200}{n}$

where V = volume at end of period of n years.
v = volume at beginning of period.

increase in volume for these trees. The average annual percentage increase in volume was computed on the basis of simple interest on the initial minimum volume. These percentages exceed the true average percentages laid on each year on the volume of that year. Pressler's formula (see footnote to Table II) based the annual rate on the average volume for the period, which has the same effect of reducing the rate though the results are not exactly the same as compound interest rates. The growth percentage for both groups of trees, using Pressler's formula, is also given in Table II. It is apparent that the healthy trees added almost three times as much substance to their volume as the needle-blighted trees during the same period.

It seems evident that the reduction in diameter growth and the corresponding loss in volume in needle-blighted trees may be attributed, largely, to the reduced size and number of functioning leaves in diseased trees. In addition to the injury to the foliage of the current year, older foliage which had been blighted in previous years is often shed prematurely (three summers on the tree is considered to be the normal life span of white pine foliage). Trees affected by needle blight for several years in succession bear progressively weaker foliage, which in extreme cases is comprised of dwarfed needles of the current year only. This condition leads to the early death of the trees.—S. N. Linzon.

A Tube Maker on Red Pine in Ontario.—The tube maker *Ocnerostoma piniariella* Zell. (Lepidoptera: Yponomeutidae), a common pest of Scots pine in Europe, was first recorded in North America at Ithaca, New York, by J. H. Comstock in 1882. Apparently the first Canadian record was made near Ottawa in 1905 by C. H. Young, and later, in 1922, it was reared from material collected at Abbotsford, British Columbia, by J. S. Boyce.

Due to its small size and to the inconspicuous nature of the injury to its host at low population levels, its distribution in eastern Canada is poorly known. Before 1955, it was recorded in Ontario only from the Ottawa area. During the past three years, however, it has been collected from various localities across the Province, and has been found in considerable numbers on a point in Lady Evelyn Lake (west of Latchford) and on an island in Onaping Lake (northwest of Sudbury).

A peculiar host-tree relationship exists among the various areas of its Holarctic distribution. In Europe it attacks Scots pine, *Pinus sylvestris* L.; in British Columbia all records are on western white pine, *Pinus monticola* Dougl.; and in Ontario larvae have been found only on red pine, *Pinus resinosa* Ait.

Field observations plus collections and rearing records have revealed the following information concerning its life history and biology in Ontario. The larvae mine the needles of red pine from early August to June of the following year when they leave the mines and construct tubes of four to six needles tied together with silk in which they pupate. Adult emergence from collections made in May and June of 1956 and 1957 occurred between June 17 and July 13, which compares favourably with field observations on moth flight. Parasitism of reared material averaged 15 per cent in 1956 and 27 per cent in 1957. The most frequent parasite reared was a chalcid tentatively identified by the Systematic Entomology and Biological Control Unit, Ottawa, as "Entedontinae, probably *Achrysocharis* sp.". The parasite *Gelis obscurus* (Cress.) was also obtained.—O. H. Lindquist, A. A. Harnden, and W. L. Sippell.

PRAIRIE PROVINCES

The Jack-Pine Budworm on Planted Pines in the Spruce Woods Forest Reserve of Manitoba, 1957.—The planting of pines has been conducted intermittently in the Spruce Woods Forest Reserve since 1904. Early objectives were to determine survival and rate of growth of several tree species under different conditions of planting. Later, great emphasis was placed on reforestation, with the hope of improving lightly stocked stands or areas covered largely by grasses. It was generally thought that pines would grow better than native spruce on the sandy deposits that are typical of the area.

The spruce budworm, *Choristoneura fumiferana* (Clem.), has been active in natural stands of white spruce in the Reserve for two decades or more, but the pine plantations in the area were practically free from attack by this species. However, the jack-pine budworm, *Choristoneura pinus* Free., showed up in the plantations in 1954. The closest natural stands of jack pine occur some 50 miles to the north, and the closest stands infested by the jack-pine budworm occur about 140 miles to the east. It is unlikely that the budworm in the pine plantations originated from invading moths. A more plausible explanation is that larvae were brought in with cones used for seed extraction and subsequent planting in the area.

Annual surveys of the plantations by L. L. McDowall show that lodgepole pine, Scots pine, and jack pine have been affected, and that the jack-pine budworm infestation had reached a critical stage by 1957.

The lodgepole pine appears to be the most severely damaged species. However, plantations of this species had been so disturbed by winter mortality and other unsatisfactory growing conditions that it was practically impossible to determine the role of the budworm in the deterioration of the trees.

Scots pine was more seriously affected than jack pine, even where plantations of the two species were contiguous. Some 22 plantations of Scots pine showed moderate to severe loss of new foliage in 1956, and in 1957 many of the trees were completely stripped of their new and old foliage. Defoliation was still light in 17 Scots pine plantations to the

end of 1957. There was some evidence that trees with light staminate flower production were more lightly defoliated than trees with heavy flower production. This supports earlier similar observations (Bi-Monthly Progress Report 13(1):2-3. 1957). Damage in the form of bare or dead tops and tree killing was light to severe on 18 plantations of Scots pine by the end of the 1957 feeding period. The greatest damage among the Scots pine occurred in three plantations that were planted during the period from 1925 to 1932. These showed 18 to 26 per cent of the trees dead and 38 to 54 per cent of the trees with the upper third of the crown dead or dying. Older trees, planted in 1905 or 1906, are beginning to attain merchantable size. These showed thin tops, but only a trace of mortality. Of 28 jack pine plantations examined, only one showed complete loss of new foliage in 1957, and 5 showed moderate loss of new and old foliage. The remainder were only lightly defoliated, and damage to jack pine has been negligible.

One of the most interesting aspects of the current infestation is an abundance of reproduction of Scots pine. Natural reproduction of this species is uncommon in Manitoba. The opening of the forest canopy as a result of defoliation presumably has encouraged germination of seeds and growth of the seedlings.—W. A. Reeks.

Treating Seedbeds with the New Sterilizer Mylone.—Caution should be exercised in sterilizing seedbeds in forest nurseries. There are two main reasons for this: (1) Once the natural microbiological buffering is lost, damping-off due to reinfestation tends to be more severe than if the soil had not been sterilized. (2) Mycorrhizal flora of soil may be reduced and this perhaps is harmful to seedlings. It may be possible, however, to prevent reinfestation by repeated applications of fungicides that are not seriously toxic to seedlings. It may also be possible that mycorrhizae are not seriously affected, or that in any event they would not offer great advantages to seedlings until these are transplanted from the rich seedbed soil. The solution of these problems should determine what importance soil sterilization will have in nurseries. Regardless of the outcome, this practice has its place when seedbeds are excessively infested by weeds, pathogenic fungi, or nematodes. A new soil sterilizer based on tetrahydro-3, 5-dimethyl-2H-1,3,5-thiadiazine-2-thione is claimed to offer the following advantages: (a) non-toxic powder when dry and thus easy to apply; (b) in moist soils it changes chemically and kills fungi, nematodes, insects, and weeds; (c) evaporates in a few days from warm soil, leaving no toxic residue; (d) contains much nitrogen which is left in the soil to act as a fertilizer.

A formulation of this chemical called Mylone was tested in several locations in replicated combinations with various fungicides. Unfortunately no or little damping-off took place in the controls or elsewhere. However, there is no question of the effectiveness of Mylone on the most important damping-off fungi *Rhizoctonia solani* Kühn and *Pythium* spp. These were killed at low dosages (about 20 p.p.m.) in laboratory tests both in agar and in non-sterile loam soil.

Two tests were conducted in Saskatoon in seedbeds of jack pine (*Pinus banksiana* Lamb.). In one test Mylone was applied at 50, 250, and 500 lb./ac. and raked into clay soil beds mixed with some peat 9 days before sowing in early June. In another test Mylone was similarly applied at 50 and 300 lb./ac. 10 days before sowing in mid June. In this test calcium cyanamide (a well-known sterilizer-fertilizer acting in much the same way as Mylone) was also applied at 100 and 500 lb./ac. No obvious phytotoxicity was found in the seedlings. The numbers and sizes of seedlings did not differ significantly in any of these treatments or in various treatments with no chemicals or with fungicides only. The 500-lb. rate of Mylone however caused a slight decrease in the sizes of the seedlings. This may have been due to temporary phytotoxicity and fertilizing effects from the excessive amount of Mylone.

The ground of these two test sites became heavily infested by various species of weeds. Mylone, especially at 300 and 500 lb. caused a pronounced reduction of weeds. This was still clearly noticeable one month after the applications. Later the plots became infested by weeds, probably seeded from surrounding plots. Fair weed control was exhibited also by the cyanamide treatment at 500, but not at 100 lb. The effect of this chemical on fungi was not studied.—O. Vaartaja.

Increment Reduction of Scots Pine Following Two Years of Defoliation by the Jack-pine Budworm.—The jack-pine budworm, *Choristoneura pinus* Free., was first recorded in pine plantations in the Spruce Woods Forest Reserve in 1954 (Bi-Monthly Progress Report 13 (1): 2-3, 1957). Populations remained at low levels in 1955, but in 1956 and 1957 Scots pine plantations were heavily attacked by this species. A damage appraisal survey was conducted at the end of the 1957 feeding period and many trees showed dead or dying tops (Bi-Monthly Progress Report 14 (1), 1958). Four sample trees were selected for an oblique sequence analysis of growth increment, using the partial sequence method described by Mott, (Mott, Nairn, and Cook. Forest Science 3 (3): 286-304, 1957). The sample trees had been stripped of both old and new foliage and from 3 to 4 feet of the main leaders were dead or dying. Discs were taken at the mid point of each internode in the top 12 feet of the crown, and at 4-foot intervals to the 1-foot stump.

Figure 1A shows the average oblique sequence of the trees for the years 1952 to 1957. The growth patterns are similar to those that have been shown for other species of conifers to which this method of analysis has been applied. The Scots pine shows a striking reduction in increment in 1956, the first year of attack, indicating that this species is very sensitive to budworm defoliation.

Figure 1B illustrates the most seriously affected of the sample trees; there was no 1957 radial growth in the top 14 feet of the crown. This tree would probably have died soon after two years of severe defoliation by the jack-pine budworm. Additional studies on mortality and recovery will continue in this area.—R. M. Prentice and L. D. Nairn.

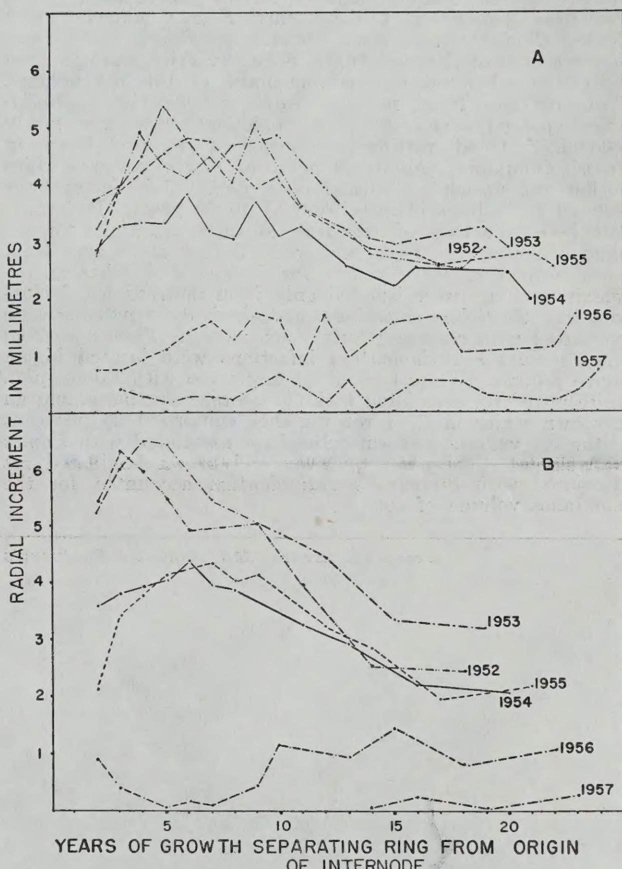

Fig. 1 Radial growth of Scots pine severely defoliated by jack-pine budworm in 1956 and 1957, plotted by the oblique sequence method. A. Average of four sample trees. B. Single tree showing the most drastic increment reduction.

BRITISH COLUMBIA

Decay in Young Western Larch in British Columbia.—The incidence of infection by wood-rotting fungi and the amount of cull resulting from decay in stands of young western larch are often very high. Since this tree forms a substantial part of the forest inventory of southeastern British Columbia, some concern has been shown regarding its apparent decadence at young ages. At the request of the British Columbia Forest Service, the Victoria Forest Biology Laboratory made a limited study of young larch in the Monashee region of the Province near Lumby. The purpose of the study was threefold, namely, to find out what types of rot occur in larch, to identify the fungi associated with these rots, and to find out at what ages western larch is severely infected.

The sample consisted of ½ acre of a mixed stand of western larch (site index 90), Douglas fir, and lodgepole pine. The stand was two-storied and had originated following two fires, about 55 and 100 years ago. The sample area had a northern exposure and a slightly sloping topography. The soil was fluvio-glacial in origin, strongly podzolized, had extreme drainage, and was compacted at about 16 inches

below the surface. One hundred and forty-three larch having a diameter of at least 2 in. (outside bark measurement at 4.5 ft.) were felled and sectioned into short lengths. Although the ages of trees ranged from 28 to 90 years and the average age was 60 years, two distinct age groups were represented in the sample, namely, trees less than 55 years and trees more than 70 years. The average age of each group was 42 and 83 years. The average size of the trees sampled was 6 in. in diameter and the range of sizes was from 2 to 12 in.

About 12 per cent of the trees in the younger age group were infected by wood-rotting fungi, whereas 58 per cent of the trees in the older age group were infected. The over-all level of infection was 22 per cent. Less than 1 per cent of the gross wood volume of the younger age group was decayed, whereas the older age group was about 12 per cent decayed. The over-all loss in wood volume from decay was 6.4 per cent. The age of the youngest infected tree was 28 years. Both the intensity of infection and the amount of rot in western larch increased with increasing size and age of trees. While the amount of rot in trees of ages 75 years and less was not significant, the level of infection remained above 10 per cent down to the 45-year age class.

Five species of fungi, namely, *Fomes pini* (Thore) Lloyd, *Corticium galactinum* (Fries) Burt, *Fomes pinicola* (Sw.) Cooke, *Coniophora puteana* (Schum. ex Fries) Karst., and *Stereum sanguinolentum* Alb. & Schw. ex Fries, were isolated from decayed wood representing most of the rot volume. Three of these fungi, namely, *Corticium galactinum, Coniophora puteana,* and *Stereum sanguinolentum* are newly recognized wood rotting organisms of western larch in British Columbia. About 88 per cent of the rot was white pocket rot associated with *Fomes pini.* This fungus was isolated from trees of ages from 81 to 90 years. It formed fruit bodies on trees of ages from 87 to 90 years and formed blind conks on an 82-year old tree. Branch stubs and trunk scars formed entrance courts for *Fomes pini,* whereas the remaining fungi were isolated only from decayed wood close to scars. *Corticium galactinum* and *Coniophora puteana* were associated with root and butt scars, whereas *Fomes pinicola* and *Stereum sanguinolentum* infections were located higher above ground. White pocket rot associated with *Fomes pini,* white pitted rot associated with *Corticium galactinum,* and an unknown white mottled rot together comprised 93 per cent of the rot volume. Brown cubical rot associated with *Fomes pinicola* and *Coniophora puteana* and brown laminated rot associated with *Stereum sanguinolentum* accounted for the remaining volume of rot.

Within the limits of the sample obtained, western larch can be infected at ages less than 30 years and more than 50 per cent of the trees in a stand can be infected at ages less than 75 years. The early establishment of *Fomes pini* in western larch, whereby more than one-third of the 80-year-old and older trees in a stand can be infected, assures the early decadence of this species in some areas. The size of the existing inventory of western larch, apart from its value in relation to other species, would appear to justify a more detailed study of the pathology of this species than that made at Lumby.—G. P. Thomas and A. L. Johnson.

RECENT PUBLICATIONS

Balch, R. E. Control of forest insects. Ann. Rev. Ent. 3: 449-468. 1958.

Bergold, G. H. Viruses of insects. *In* Handbuch der Virusforschung IV (3 Erg. Bd.).: 60-142. 1958.

Brown, N. R. and Clark, R. C. Studies of predators of the balsam woolly aphid, *Adelges piceae* (Ratz.) IV. *Neoleucopis obscura* (Hal.), an introduced predator in Eastern Canada. Can. Ent. 89: 533-546. 1957.

Embree, D. G. The external morphology of the immature stages of the beech leaf tier, *Psilocorsis faginella* (Chamb.), with notes on its biology in Nova Scotia. Can. Ent. 90: 166-174. 1958.

Etheridge, D. E. The effect on variations in decay of moisture content and rate of growth in subalpine spruce. Can. J. Bot. 36: 187-206. 1958.

Evans, D. Two-year life cycle of *Pseudohazis eglanterina* (Boisduval). Can. Ent. 90: 125-127. 1958.

Faulkner, P. Polyol dehydrogenase of the silkworm. Biochem. J. 68: 374-380. 1958.

Holling, C. S. A radiographic technique to identify healthy, parasitized, and diseased sawfly prepupae within cocoons. Can. Ent. 90: 59-61. 1958.

Martin, J. L. Observations on the biology of certain tortricids in young coniferous plantations in southern Ontario. Can. Ent. 90: 44-53. 1958.

McGuffin, W. C. Biological and descriptive notes on noctuid larvae. Can. Ent. 90: 114-124. 1958.

Rose, A. H. Some notes on the biology of *Monochamus scutellatus* (Say). Can. Ent. 89: 547-553. 1957.

Silver, G. T. Studies on the silver-spotted tiger moth, *Halisidota argentata* Pack., in British Columbia. Can. Ent. 90: 65-80. 1958.

Webb, F. E. Developments in forest spraying against spruce budworm in New Brunswick. Pulp and Paper Mag. of Can. 59 (C): 301, 302, 304, 306, 308. 1958.

Edmond Cloutier, C.M.G., O.A., D.S.P., Queen's Printer and Controller of Stationery, Ottawa, 1958

O. H. M. S.

SCIENCE SERVICE
DEPARTMENT OF AGRICULTURE
OTTAWA